Milwaukee Metropolitan Sewage
Treatment Plant
700 East Jones Street
Milwaukee
Milwaukee County
Wisconsin

HAER No. WI-3

HAER
WIS,
40-MILWA,
37-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Rocky Mountain Regional Office
Department of the Interior
P.O. Box 25287
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HISTORIC AMERICAN ENGINEERING RECORD

Milwaukee Metropolitan Sewage Treatment Plant
(Jones Island Wastewater Treatment Plant)

HAER No. WI-3

Location:	700 East Jones Street Milwaukee, Milwaukee County, Wisconsin (in the vicinity of UTM Coordinate 16.426600.4793500
Dates of Construction:	1918-26; altered in 1934, 1952, and at many other times; extensive demolition and renovation occurred in 1982-84
Engineers:	T. Chalkley Hatton, Chief Engineer; Harrison P. Eddy, Consulting Engineer
Owner:	City of Milwaukee
Significance:	The Jones Island Plant was one of the first sewage treatment plants in the United States to employ the activated sludge treatment process successfully. It was the first treatment facility to economically dispose of the recovered sludge by producing an organic fertilizer. Though by the early 1980s the plant had reached the limit of its effectiveness and required extensive rehabilitation, this does not detract from its historic significance as a pioneering facility in the field of pollution control technology.
Historical Report Prepared by:	Raymond H. Merritt, 1982

Note: As described in the Milwaukee Metropolitan Sewerage District's Master Facilities Plan, the Jones Island Plant was scheduled to be removed or significantly altered. The Milorganite manufacturing process for sludge disposal was modified or abandoned and some facilities in the process removed. The first construction activity occurred in 1982 and included the construction of a chemical unloading facility as well as clearing work. Removal of the Incinerator Building and part of the Fertilizer Storage Building in addition to other demolition work took place in 1983 and 1984.

SIGNIFICANCE

The Jones Island plant was one of the first sewage treatment plants in the United States to employ the activated sludge treatment process successfully, and it was the largest such plant of its time. It was the first treatment facility to economically dispose of the removed sludge by producing an organic fertilizer. This product is marketed under the trade name "Milorganite" and has been a popular fertilizer for golf courses and other commercial users since it was introduced.

In August 1974, the plant was designated a National Historic Civil Engineering Landmark by the American Society of Civil Engineers and cited as a unique and innovative facility. Charles W. Yoder, President of the organization, stated, "Milwaukee's plant is America's earliest large scale activated sludge type municipal sewage treatment facility. Construction of the plant started in 1919 and, in its time, was a major improvement over existing systems. The successful operation of Milwaukee's...plant has led the way for many other...municipalities..." (ASCE press release, 13 August 1974). The Jones Island facility is the only sewage treatment plant in the country to have been designated a national landmark by the ASCE. In 1979, it was placed on the National Register of Historic Places because of its historic leadership in developing what has become a leading sewage treatment method throughout the world.

Organization of the Sewerage Commission

To appreciate the magnitude of the achievement of the Jones Island Plant, it is important to understand its historical context. The Sewerage Commission of the City of Milwaukee was created by the State Legislature in 1913 and began its work in 1914. The events leading up to its creation played a major role in area politics in the early 30th century.

The City of Milwaukee was granted the power to build sewers as part of its original charter in 1846 and during its first 20 years, several sewers were constructed to carry wastewater to the rivers and the lake. Most of the city's domestic sewage was simply absorbed by the soil. The rest was carried to nearby bodies of water. Virtually all of the sewage reached the city's surface water or groundwater supplies

By 1866, the rivers and lakes were noticeably polluted, so the Legislature created a sewerage commission to address this problem throughout the entire drainage basin of the Kinnickinnic, Menomonee and Milwaukee Rivers. This group failed to accomplish anything and was disbanded in 1868. Its responsibilities were transferred to a newly created Board of Public Works which continued to govern wastewater issues until 1913 (Horvath, p. 3).

In 1879, the Common Council appointed a blue-ribbon engineering commission to investigate the sewage situation and "aid in devising a scheme for abating the river nuisance" (Milwaukee Sewerage Commission (MSC), Eighteenth Annual Report, 1931, p. 134). The commission consisted of three prominent sanitary engineers: E.S. Chesborough, Moses Lane, who in 1875 served on a similar commission in Boston, and Col. George E. Waring, who in 1880 would be responsible for one of the country's first separated sewer systems in Memphis, Tennessee (Eddy, p. 693).

The commission recommended that a series of low-level intercepting sewers be constructed parallel to the rivers and connected to the sewers already draining directly into the watercourses. The interceptors would convey sewage to a pumping station which would pump it directly into Lake Michigan somewhere south of the harbor entrance. This was considered a temporary solution until a full-scale treatment effort was warranted (MSC, Eighteenth Annual Report, 1931, p. 34). At the time, the public was concerned with the deteriorating conditions of the three rivers caused by direct discharge of domestic and industrial sewage.

Lake Michigan, the city's water supply, was thought to be large enough to dilute the sewage.

The Menomonee River, which ran through the industrial center of the city, was the most polluted of the three rivers. Therefore, in 1880, the Board of Public Works authorized the construction of an intercepting sewer in the Menomonee River Valley and also a pumping station on the north end of Jones Island at the mouth of the harbor. The pumping station would pump raw sewage up from the interceptor through a conduit far enough into the lake to remove most dangers of contamination at the city's North Point water intake and its bathing beaches north of downtown Milwaukee. The system was put into operation in 1886 (Horvath, pp. 4-5) and pollution in the Menomonee River was reduced. However, the Council decided against similar projects for the other two rivers because of high construction costs.

In 1886, George H. Benzenberg, the City Engineer, recommended construction of a flushing tunnel for pumping large volumes of lake water into the Milwaukee River below the North Avenue dam to dilute the polluted river water, accelerate the current to prevent settling, and raise the level of dissolved oxygen to help reduce odors (Leary, p. 2). The Common Council approved the project in 1887 and a 2,543-foot tunnel was driven west from the lake to a point on the river just below the dam. The flushing tunnel was 12 feet in diameter and could pump 324 MGD of lake water into the river. It was completed in 1888 and operated only during the summer months until 1895 when the continued deterioration of water quality necessitated year-round use (Horvath, p. 6). The condition of the river improved markedly but the sewage was simply being transferred from the river to the lake.

A flushing tunnel for the Kinnickinnic River was proposed in 1898, but various controversies prevented its actual construction until 1907. Its effect on the river was similar to that of the flushing tunnel in the Milwaukee River.

Despite these efforts, the condition of the rivers worsened and a second group of sanitary engineers was assembled to examine the problem. The committee was chaired by City Engineer Benzenberg and included Thomas J. Whitman, Joseph P. Davis and Henry Flad. The report they submitted on the final disposal of sewage and the protection of the water supply recommended construction of a series of intercepting sewers to collect the flow in the sewer system and carry it a mile out into the lake to a point south of the city between present day Cudahy and South Milwaukee. This proposal involved no sewage treatment and the Common Council felt it was too expensive as a temporary solution (MSC, Eighteenth Annual Report, 1931, p. 136).

By 1900, the quality of the drinking water supply was beginning to be affected by the river pollution being flushed and pumped into the lake as well as that already conveyed by the river. Just as the potentially serious health hazard was becoming evident, the issue became caught up in a local political struggle for City Hall between the Socialists and the nonpartisans (Horvath, pp. 8-26).

The political debate was over the method by which the problem should be solved and the way in which it was to be executed. A group of nonpartisan aldermen proposed that the city create an independent sewerage commission and charge it with erecting a disposal plant to treat the sewage before it was pumped into the lake. The Socialists objected to both the cost of the project and the concept of a sewerage commission outside the control of the Council. They proposed a water filtration plant which would cost less, solve the immediate threat to the water supply, and be part of the Department of Public Works under the control of the Council and the Mayor.

The debate continued into 1905 when Mayor David Rose, a Socialist, learned from the City Health Department that the water supply was bordering on contamination. The Common Council was asked to investigate, but little was done until 1908 when Dr. Gerhard A. Bading, Commissioner of Health, began a vociferous campaign to protect the city's water supply through sewage treatment. Bading's entry into the debate was caused by the opening of the Kinnickinnic River flushing tunnel in 1907 and a proposal to construct a third tunnel for the Menomonee River. Bading claimed that flushing the polluted river water into the lake only worsened the quality of the lake water and hastened contamination of the city's drinking water supply. He felt that a sewage treatment plant was the only permanent solution to the problem.

In August 1909, the Council finally acted following a typhoid scare in the city. A third group of sanitary engineers of national reputation was asked to recommend a solution to the problem of river and lake pollution. The engineers were John W. Alvord, George E. Whipple, and Harrison P. Eddy of the Boston firm of Metcalf and Eddy, who would be involved with the Milwaukee project as a consultant into the 1930's. They presented their report to the Common Council in April 1911. Their recommendation that the city build both a disposal plant and a filtration plant pleased neither the Socialists nor the nonpartisans. However, the engineering commission felt that the filtration plant was the most desirable and cost-effective solution in the short term, a conclusion which supported the Socialist position (Leary, pp. 6-9).

The commission prepared an extensive report, but its overall effect was negligible, primarily because of the way in which its recommendations became political fodder. A great deal of opposition was raised to these plans. The nonpartisans, who under the leadership of Dr. Bading won the Mayor's office and a majority in the Common Council in the 1912 elections, were opposed to the scaled down scope of the disposal plant. Bading also objected to the emphasis on flushing the rivers as a stopgap measure. Milwaukee's south-siders opposed the recommended location of the plant in their part of town, and the Socialists complained about the estimated cost of the project.

In the summer of 1912, nonpartisan strength and support for a disposal plant grew. Socialist proposals for the $1.5 million filtration plant and the $250,000 Menomonee River flushing tunnel recommended in the 1911 report were defeated in the Common Council, and Mayor Bading's hand was strengthened by the support of the new Commissioner of Health and the Greater Milwaukee Association. The Health Department was finding pollution in City Hall tap water 40 percent of the time and a declaration was made that only a disposal plant could solve the problem permanently. The prestigious Greater Milwaukee Association endorsed the Mayor's position and called for the formation of an independent sewerage commission to direct development of a citywide sewage disposal system.

The debate continued into early 1913. South-siders complained that the plantsite proposed in the 1911 report was too close to industries and residences and could prove a greater health hazard than the water supply. Leaders of this group promoted Jones Island as a better site. However, Alvord, Whipple and Eddy objected to Jones Island on the grounds that a costly landfill would be needed for a plant of the size they envisioned, the location at the harbor mouth could interfere with navigation, and the plant would be too close to the city's water intake (Horvath, p. 21).

A south side Socialist coalition was able to block progress temporarily. In an effort to overcome opposition from the south side, the nonpartisans sponsored a resolution to create an independent sewerage commission which would have the power to select a plantsite, request its own budgets, and so on. On 13 February 1913, a bill calling for the Legislature to create a sewerage commission was presented to the Council. It was given to the Committee on Legislation, which immediately asked Socialist City Attorney Daniel Webster Hoan to rule on its legality. Although Hoan opposed the bill politically, he was unable to declare it unconstitutional. He attempted to delay his report by asking a series of questions about the proposed body. While the Committee awaited B an's ruling, the arguments continued.

In March 1913 after 4 days of debate, the nonpartisans in the Council were able to approve the resolution and forward the bill to the State Legislature, which passed the bill in June. The duties of the Commission were clearly laid out:

> ...[the] Commission shall be charged with the duty of projecting, planning, constructing, and establishing a sewerage system for the collection, transmission, and disposal of the house and other sewage and drainage of...such city...and shall be clothed with...all powers...necessary (Wisconsin <u>Laws and Statutes</u>, Chapter 608. 1913).

It also had the power to require any industry in the city needing sanitary sewerage service to comply with its regulations.

The Sewerage Commission was completely independent of the Common Council, whose only influence over the Commission was in the confirmation of the Mayor's appointments. Because the terms of the Commissioners were unlimited, the nonpartisans were confident that their plans for the treatment plant could not be blocked by a new Socialist mayor or Council majority once the original nonpartisan Commission had been seated.

The Legislature had granted the Commission permission to levy a one mill tax on property and a yearly issuance of bonds up to a limit of $10 million over the life of the Commission. Thus, even budgetary considerations had been successfully removed from

Council influence. The Commission was also given a degree of metropolitan authority by being entitled to review any plans for disposal plants proposed by any municipality in the drainage area and to make recommendations on those plans.

On 17 September 1913, the Common Council confirmed the new Commissioners appointed by the Mayor. George Benzenberg was Chairman and the other members were George Miller, Michael Carpenter, Conrad Niederman and Theodore O. Vilter, all proponents of a disposal plant. The Commission had its organizational meeting on 7 October 1913 and resolved to quickly solve the problems at hand. It was too late in the year to use the one mill levy, so the Commission requested a bond issue to meet expenses. The Socialists and several nonpartisans combined to defeat the measure. This coalition continued to block bond issues through 1916, seriously handicapping the Commission's work. The Commission was without its own means of funding until the fall of 1914 (Horvath, pp. 29-30).

Early Research and Development, 1914-16

The Sewerage Commission began working in earnest toward creating a healthier water supply in 1914. Following a nationwide search, T. Chalkley Hatton, a noted sanitary engineer from New York, was appointed Chief Engineer of the Milwaukee project on 6 January. He quickly hired William R. Copeland, a chemist, and D.W. Townsend, a draftsman, to assist him. Both men remained with the Commission for many years.

The enormous task of designing the city's disposal system began with the testing of current disposal methods. The tests were supposed to take a year to complete following the erection of a testing station next to the pumping station on Jones Island. This location was chosen so that raw sewage from the Menomonee interceptor could be obtained to conduct the tests. The Menomonee interceptor carried domestic sewage as well as the discharges of several major industries including tanneries, soap works, packing houses, breweries, malthouses, and dye works, among others. It was felt that if a satisfactory treatment technique could be developed for this combination of sewage, it could be used to treat the sewage from the entire city. The first tasks of the new staff were to prepare plans and specifications for the laboratory and testing station. Construction of the laboratory began on 1 May 1914 and testing began on 15 September (MSC, First Annual Report, 1915, p. 23).

In August 1914, the Commission agreed to Hatton's recommendation that a single plant be designed to meet the needs of the entire city. Hatton and the Commission were aware that they were breaking relatively new ground. In its first annual report, the Commission stated, "...there is no city, aside from Baltimore, which has just commenced operating a sewage disposal plant, anywhere near the size of Milwaukee, which has built and operated a sewage disposal plant wherein the sewage is treated by modern processes" (Ibid., p.7).

The testing station is shown in Exhibit 2. During the testing, all sewage (approximately 400,000 gpd) passed through sets of coarse and fine screens to remove large solids. The flow was pumped into a grit chamber 35 feet above ground where sand, gravel and other material were allowed to settle out. From there, the liquor was diverted to several purification processes. Records were kept of all the screenings and grit collected to determine their volume and composition and to assist in the design of the permanent plant (Ibid., p. 61).

The first three methods investigated were the Imhoff tank process for digesting sludge, chemical precipitation using iron sulphate, and precipitation in a slate-lined colloider. The effluent from these processes was disinfected with liquid chlorine before it was pumped to the lake. The sludge was spread over a limestone drainage bed to dry and then incinerated. The drainage bed froze in the winter and the sludge from the chemical precipitation tank did not drain well at any time (Ibid., pp. 62-3). The electrolytic or Lautzenheiser process, tested in 1915, was supposed to separate sludge from clear fluid by means of electric current, but was abandoned after a month as unworkable.

In late 1914, the Sewerage Commission learned of the work of Dr. Gilbert J. Fowler of Manchester, England. Fowler's "activated sludge" treatment process was a new approach to sewage disposal. In this process, a population of microorganisms - the activated sludge - is mixed with raw wastewater and oxygen to oxidize impurities in the wastewater. The sludge is then separated from the wastewater. Negotiations with Fowler allowed the Commission to experiment with his process and have him provide guidance and review its findings (Ibid., p. 19).

Initial experiments with this process in the Jones Island laboratory were so successful that in April one of the chemical precipitation test tanks was converted for further testing. This tank was set up on the "fill and draw" principle, by which the screened sewage is drawn into a single tank, mixed with activated sludge and aerated, and the organic sludge is allowed to settle out.

These experiments, which essentially duplicated Fowler's (MSC, Second Annual Report, 1914, p. 30), proved satisfactory, so a tank was designed to see if the process could work on sewage that moved through the process continuously from entry to discharge. The sewage passed slowly through a specially constructed 80-foot aerating chamber to allow thorough interaction with the compressed air, and then to a sedimentation tank where the sludge precipitated out. Some of the sludge was pumped back to the aeration tank to mix with the raw sewage and start the process over. The rest was collected and spread on a filtering bed to dry and the effluent was pumped into the lake. The process worked extremely well and, with the exception of some maintenance periods, functioned continuously after it was started on 1 July 1915. This was the first time continuous flow treatment had been attempted and the plant attracted hundreds of visitors interested in the process. The unanimous opinion of both staff and visitors was that the continuous flow processed produced the best effluent of any of the methods tested (Ibid., p. 31).

While the early experiments with activated sludge were promising, the problem of disposal of the large amounts of waste sludge became evident. Chemical tests indicated that the sludge was rich in nitrogen and could be used as a fertilizer base but only after it was dehydrated, degreased and dried. Drainage beds, though fairly effective, could be used only 6 months of the year unless they were covered and heated. Experiments with filter presses began and continued for several years (Ibid.).

Activated sludge treatment surpassed every other method tested for quality of effluent and cost. It removed 95 percent of the bacteria and 90 percent of the solids suspended in the sewage, and the recovered sludge had potential economic value. At Hatton's request, the Commission authorized construction of a 2 MGD testing station in mid-1915 to investigate refining the process for use in a permanent disposal plant. It was felt that, despite the promise exhibited by this method, large-scale testing was necessary to decide upon its use. Meanwhile, testing of other treatment methods continued in the event that the activated sludge process might not meet expectations (Ibid., p. 33).

The new testing station (Exhibit 4) was located on city-owned land adjacent to the first station and laboratory on Jones Island to obtain sewage for testing. The 2 MGD capacity was fixed by the area available for construction.

The pilot plant consisted of 11 reinforced concrete circular tanks 30 feet in diameter and 13 feet deep. Eight tanks were for aeration of the mixed liquor, two were for aeration of the activated sludge, and one was for final sedimentation. Each tank was divided by a baffle wall which formed a spiral through the chamber that was 6 feet wide and 114 feet long. Fine bubble diffuser (filtros) plates, through which pressurized air could pass but water could not, lined the bottom of the chambers. The sedimentation tank had a hopper bottom to collect the settled sludge. Some sludge was returned to the sludge aeration tanks and the rest was delivered to a press for dewatering (Ibid.).

The pilot plant was completed in February 1916, but testing began in late January as soon as the first six tanks were completed. With the exception of several short shutdowns due to mechanical problems and adjustments to the equipment, the plant ran successfully until 29 August when the sewage pump to Jones Island broke down. The plant remained shut down through the end of 1916 and full operation was not restored until the following spring (MSC, Third Annual Report, 1916, p. 34 and Fourth Annual Report, 1918, p. 34).

Several policy changes further shaped the development of the permanent plant. The Chief Engineer, with the consent of the Commission, quietly stopped testing other treatment methods and began to refine the activated sludge process. All testing turned to finding the most efficient way to put the process to work on a large scale. The cold weather and the snow and ice from the streets did not retard the treatment process, proving it could be used in the Wisconsin climate which had hampered the efficiency of several other techniques. In the spring, the Commission approved continued experiments on dewatering and drying the sludge as well as finding the most efficient methods of aeration and sedimentation. The Commission acquired the abandoned U.S. Coast Guard Lifesaving Station adjoining the pumping station to provide more office and laboratory space (MSC, Third Annual Report, 1916, pp. 3-6, 20, 34). These developments throughout 1916 indicate that the Sewerage Commission was approaching the point where it could formally adopt a treatment process and proceed with construction of the plant. Yet it was not until 1925 that the first portion of the plant was opened.

The Location of the Plant

While various treatment methods were being tested between 1914 and 1917, the City and the Sewerage Commission sought a permanent site for the plant. Milwaukee's south-siders had opposed construction of the plant largely because the 1911 Alvord, Whipple and Eddy report had recommended the plant be located on the south side. To stem that opposition, the Commission and Chief Engineer Hatton went on record as favoring Jones Island for the location of the plant. The advantages of that location were declared to be its proximity to the Menomonee interceptor and pumping station and its remoteness from residential and industrial areas, although the last point was only partly true.

"Jones Island" was originally a peninsula in the Milwaukee River north of its natural outlet to the lake. It was separated from the sandbar that served as the shore by a marshy area which, by the late 1840's, had dried up and made the island part of the sandbar. Before Milwaukee was founded, several Indian villages were located there. In 1848, Captain James M. Jones opened a shipyard on that land which then acquired his name.

Because of growing concern about navigation of the river mouth and a desire to get larger ships up the river, a plan for a straight-cut channel across the sandbar 3,000 feet north of the old river mouth was approved in 1852. The work was completed in 1857 and an area between the old river mouth and the new harbor entrance that encompassed about 100 acres was created (Gurda, p. 54).

The channel ruined Jones's operation by severing his supply line with the mainland. Furthermore, a disastrous storm that year destroyed most of his shipyard. By 1861, he was forced to leave the island which had become some of the least desirable real estate in the city. By the end of the Civil War, the lack of river current had filled in the old river mouth and the island became a peninsula again, this time attached to the Bay View area to the south (Exhibit 5; Ibid., p. 77).

When it was rejoined to the mainland, Jones Island once again became inhabitable. A downtown merchant moved several small houses from North Water Street to the island and a squatter's community of a few families of German immigrants began to develop. The real settlement of Jones Island began in 1872 when Jacob Muza arrived from the Kaszuby region of Poland, a small area on the Baltic seacoast populated by fishermen, and laid claim to all the uninhabited land on the island. Muza wrote to friends and relatives in Poland of a new fishing village and his countrymen began to settle there in large numbers (Exhibit 6). There were only 12 houses on the island in 1875, but by 1900, the population reached 1,200 to 1,600 (Ibid., pp. 78-9). These people were eventually displaced by the City of Milwaukee for construction of the Jones Island plant and expansion of the Port of Milwaukee. By 1922, the last of the Kaszub community had left the island.

Construction of the Plant

Condemnation proceedings for the portion of Jones Island needed for the treatment plant were originally discussed in 1914. In 1915, the Common Council officially became involved since the condemnation was ultimately the responsibility of the city government. A jury was appointed to determine whether the project warranted the taking of private property. A report issued in October 1916 stated that such confiscation was warranted and that the construction of the plant was in the public interest. A report on costs was requested for the spring of 1917 and the process of acquiring the site of the permanent plant began (MSC, Third Annual Report, 1916, p. 12).

In mid-August 1917, Chief Engineer Hatton reported to the Sewerage Commission that the activated sludge process was the most economical treatment method; it provided the cleanest effluent; and of the various methods tested, it alone offered a marketable waste byproduct. He recommended that the Commission formally adopt the activated sludge process and the preliminary plans he had prepared, and that the final design of the plant be begun as soon as possible (MSC, Fourth Annual Report, 1918, p. 21).

The Commission agreed that, from the point of producing the most sanitary effluent, the activated sludge process seemed to be the best solution. However, it noted that the process was untried on a scale similar to that proposed for Milwaukee. The plant would require expensive, large-scale equipment, some of completely new design. Furthermore, some of the tests completed at the testing station raised many new questions. Experiments were still being conducted to find the most efficient means of aeration, and the successful and economical dewatering of sludge for production of fertilizer was beginning to look doubtful (Ibid., p. 5).

Instead of endorsing Hatton's recommendation, the Commission referred the plans to Harrison Eddy, who had participated in the 1911 study, for a second opinion. Eddy's report, submitted on 27 December, essentially supported the Commission's position. He advised further experimentation in the areas where problems with the process remained. In response, Hatton suggested a series of experiments that could be undertaken.

On the basis of Hatton's reply, the Commission ordered plans and specifications for a new 1 MGD demonstration plant on Jones Island which would be essentially a scale model of the plant proposed by Hatton. Eddy was retained as a consultant to the Commission and the Chief Engineer throughout the design and construction of the plant (Ibid., pp. 21-2). Instead of initiating project design late in 1917, the Commission ordered a new set of experiments to address questions about operation of the process.

The cost of a new demonstration plant was too high, so the plant was built using components of the 2 MGD testing station. Reconstruction began in April 1918 and was not finished until October. The demonstration plant had a set of coarse screens; a grit chamber similar to the one Hatton designed for the permanent plant; a fine screening mechanism developed by the Chain Belt Company; two aeration tanks, each 15 feet deep with equal surface areas but slightly different diffusion ratios; two 10-foot deep aeration tanks with the same surface areas and diffusion ratios as the 15-foot tanks; two 11-foot square sedimentation tanks and two 9-foot square tanks, all 15 feet deep and equipped with mechanical sludge thickeners from the Dorr Company of New York; four sludge storage tanks with air diffusers; two types of sludge presses from the Berrigan and Simplex Companies; and a Buckeye Dryer. All portions of the plant were metered to record the data needed to guide plant design. A completely new laboratory was installed in the old Coast Guard station (MSC, Fifth Annual Report, 1919, pp. 32-3). Exhibit 7 is a diagram of the demonstration plant.

In December 1917, Hatton convinced the Sewerage Commission to begin design and construction of items that were unlikely to change as a result of the new experiments; that is, the low-level pumping station, coarse screens and regulating valves and grit chambers. Plans and cost estimates for those items were presented to the Commission in July. Hatton also urged the speedy completion of the interceptor sewer system started in 1915 and the large inverted siphons under the harbor started in 1916 so that all of the city's sewage could be delivered to Jones Island by the time operation of the first portion of the plant began. He recommended that a chlorination plant be added to the system so that the sewage could at least be screened and disinfected before being pumped into the lake (Ibid., p. 36).

In late 1918, contracts were let for the first structures in the permanent plant. The first items under contract were the three 30 MGD centrifugal pumps designed to pump sewage from the low-level interceptors up to the plant. The pumps were purchased from the Allis-Chalmers Company for $114,500 and assembled at the site by plant laborers to save expense (MSC, Sixth Annual Report, 1920, p. 22).

Construction contracts were let in December to the Coffin Valve Company for sluice gates in the Coarse Screen House to control the influent flow; to the Flowers, Stephens Manufacturing Company for gate valves in the coarse screen, valve and grit chambers; and to the Klug and Smith Company for construction of the pump well, coarse screen chamber and valve chamber (MSC, Fifth Annual Report, 1919, pp. 25, 27). The Klug and Smith contracts, all within the Coarse Screen House, constituted the first structural work on the new plant. In March 1919, the Klug and Smith Company also received the contract to construct the grit chambers and the conduit from the coarse screens to the grit chambers. All of these contracts were delayed several months by the need for approval by the War Production Board in Washington. The work on the initial portion of the plant was completed in early 1920 at a contracted cost of $328,338 (MSC, Sixth Annual Report, 1920, pp. 19, 26).

In September 1919, the Klug and Smith Company received contracts valued at $83,194 to build superstructures over the pump well, coarse screens and sluice gates at either end of the grit chambers. These buildings were to reflect the recommendations of three local architects - Alexander C. Eschweiler, Carl Barkhausen and Richard Philipp - who were invited by the Commission to serve as an Art Committee. This group was charged with developing design guidelines for the building exteriors "to the end that the plant may be artistic as well as practical and in utmost good taste" (Ibid., p. 8).

The Sewerage Commission wanted the treatment plant to be as well designed as any other public buildings. It also wanted to conceal the plant's rather unattractive function with a harmonious, attractive facade. The Art Committee prepared an overall site plan that showed the general design of the buildings and their relative positions (Exhibit 8). This plan and the design guidelines developed were formally adopted by the Commission and became the basis for all the building exteriors at the plant.

Although the buildings were constructed by many different firms, the Art Committee's recommendations were adhered to throughout. Richard Philipp provided additional assistance in preparing specifications for construction of the Coarse Screen House and the Grit Chamber Gate Houses as well as in selecting materials for the exteriors (Ibid., p. 33). The buildings, therefore, probably reflect Philipp's influence to a somewhat greater extent than Eschweiler's or Barkhausen's.

Although plans and specifications were approved and architectural guidelines set, construction of the plant was continually delayed. Due to the shortage of manpower caused by the war as well as strikes by workers already employed on the island, no progress was made toward raising these first structures in 1919 (Ibid., p. 26).

Planning, however, was not delayed. On 5 September 1919, Chief Engineer Hatton presented plans for the temporary chlorination plant that included construction costs and evaluated the plant's advantages and disadvantages. Supporting reports were submitted by Chief Chemist Copeland and Harrison Eddy, but the Health Commissioner, the Superintendent of the Water Works and his consulting engineer protested the plans, stating that large amounts of chlorine in the effluent could harm the water supply. Because of these fears and the high cost of the installation, the chlorination plant was removed from the Commission's development program (Ibid., p. 10).

In November, a final political effort was made to stop the project. The Sewerage Commission's 1920 construction budget was questioned by the Board of Estimates and a meeting was called to answer questions on the project. It was requested that the Commission's consultant, Harrison Eddy, be present. The meeting scheduled for 6 November in the Council chambers was attended by the Council, the Commission and its staff, and interested citizens. Mayor Hoan asked Eddy to answer several questions that had been supplied to Eddy earlier in writing.

Hoan had defeated Mayor Bading in the 1916 election and, as discussed previously, wanted a water purification plant instead of a disposal works. He and the Socialists had passed a resolution in the Council calling for construction of a filtration works and his questions revolved around this change in circumstances. Hoan hoped that Eddy, whose earlier reports had not favored the process or the project, might provide some political ammunition with which to block construction. He asked Eddy if it was still necessary to expend millions of dollars on the activated sludge process or whether another method would not be just as good. He also asked whether the plant should be built in units rather than all at once. Eddy replied that the activated sludge process worked, it was the most economical method tested, or close to it, and it offered a potential payback through fertilizer manufacture. He added that the plant should be built in its entirety to the projected 1930 need. This reversal from the position he held in 1917 was based on changed conditions on Jones Island and the progress made in the experiments at the testing station.

Eddy then recommended that the Commission formally adopt the activated sludge process, which it promptly did. Although the Commission had considered only this process since 1917, it was never formally endorsed (Milwaukee Journal, "Consultant Supports Project," 13 November 1919; MSC, Sixth Annual Report, 1920, pp. 12-13; Horvath, p. 49). The Commission adopted the activated sludge process for the following reasons:

- The entire discharge of the city and its lakeside suburbs was being dumped into the lake within a few miles of the the city's water intake.

- Drinking water had been contaminated periodically since 1910 and filtration alone did not remove all the pollutants.

- Milwaukee was redeveloping its harbor and there was concern over the ability to attract Great Lakes shipping if the harbor was polluted with raw sewage.

- There was concern over maintaining the quality of the local bathing beaches.

- Sufficient land for drying and disposing of the large amounts of solid waste that would be recovered by sewage treatment was unavailable.

- The cost of the activated sludge process was comparatively low.

On the basis of Eddy's testimony, the Board of Estimates approved the Commission's bonding request and removed the last obstacle to construction. The Commission officially endorsed the activated sludge process on 12 November and ordered Hatton to produce plans and specifications for the rest of the plant. A policy statement was adopted to the effect that, since the interceptor system was nearly complete, the treatment plant would be pushed to quick completion. In December, following a study comparing the cost of purchasing electricity and producing it at the site, Hatton's proposal that a power plant be constructed on the island to supply necessary power and compressed air was approved, and plans and specifications were ordered (MSC, Sixth Annual Report, 1920, pp. 12-16). After 5 years of tests, delays and more political controversy, construction of the plant swung into high gear.

Construction activity was constant during 1920. Of the projects started in 1918 and 1919, the installation of sluice gates was completed in December 1919 and the gate valves in April 1920. The three centrifugal pumps were delivered and set up in the low-level pump station well, but because the proposed chlorination plant was cancelled, the electrical controls were stored to protect them from the elements until the pumps were actually required. The grit chambers were completed in June and the pump well, valve and coarse screen chambers, and sewage conduit were completed in August 1920. The superstructures for the valve and coarse screen chamber and the Grit Chamber Gate Houses were completed by late October (MSC, Seventh Annual Report, 1921, pp. 19-25). The Chief Engineer reported that "the results have been very pleasing and indicate that the whole plant will be correct in architectural treatment, thus being pleasing to the sight in addition to being a utility" (Ibid., p. 25). Exhibits 9 and 10 show the Coarse Screen House and the Grit Chamber Gate Houses under construction.

Several other major projects were also started in 1920, the most ambitious of which was the recovery of 10.75 acres of land from the lake for the site of the aeration and sedimentation tanks (Exhibits 11 and 12). This project was undertaken by the Great Lakes Dredge and Dock Company which started work in April and completed it in early 1921 at a cost of approximately $276,000. The project entailed the construction of a pile pier that was then filled with stone and surrounded by a protective bulkhead and a steel sheetpile cofferdam. A hydraulic dredge was used to fill in the area with excavations from the lake bottom and harbor entrance and pumps were used to dewater the site (MSC, Seventh Annual Report, 1921, p. 27). With the exception of the channel at the harbor entrance and some fill along the beaches, this project was the first of several changes to Milwaukee's shoreline.

The Commission also constructed a small factory on the island for making the concrete forms required by the aeration tanks. To provide compressed air for mixing the sewage and activated sludge, 18,000 porous filtros plates had to be installed in the 24 aeration tanks. These plates required concrete containers and separators which could be constructed more cheaply at the plant by day labor than by a vendor. The plant consisted of two sheet metal buildings designed to be dismantled and sold when the work was completed.

The third major project started in 1920 was the design and specification of equipment for the plant's Power House. Plans called for the Power House to provide all the electricity required to operate the plant as well as all the compressed air used in the aeration process. This was considered to be a major engineering undertaking and a great deal of effort was spent to ensure its success.

Four types of power plant systems were examined by Chief Engineer Hatton, Will J. Sando, the Commission's mechanical engineering consultant, and Leonard Metcalf of Metcalf and Eddy. The types of equipment considered included horizontal, vertical, centrifugal and hydroturbine blowers with reciprocating steam, high pressure steam turbine, and diesel oil engines. Sixteen combinations of machinery were evaluated for performance, efficiency of operation, and capital cost. Proposals for these combinations were submitted by two Milwaukee firms, the Allis-Chalmers Manufacturing Company and the Nordberg Manufacturing Company.

The three engineers selected a plant consisting of centrifugal or turbine blowers driven by steam turbines and generators driven by steam turbines. The plant offered by Allis-Chalmers was bid at $550,000, the lowest bid that met the Commission's specifications, and had the lowest annual operating costs (Ibid., pp. 29-37).

By the end of 1920, more than $1.5 million had been spent or contracted for construction work and capital equipment for the new plant. The first phase, consisting of the coarse screens and grit chambers, was completed and work had begun on the second phase involving the activated sludge process itself.

No superstructures were erected in 1921, although a great deal of work was completed at the plant. Nearly 22,000 wooden piles were driven in the fill area preparatory to laying the foundation for the aeration and sedimentation tanks, and by the end of the year, plans and specifications for the tanks themselves were approved so that construction could begin early in 1922.

The foundations for the Power and Boiler Houses were also completed by the end of the year. The temporary casting plant began making the 24,000 concrete castings for the aeration tanks. Specifications called for 8,900 concrete containers for the diffuser plates which were 8 by 9 feet and separated by 15,000 concrete ridges 6 feet 7 inches high by 2 feet 5 inches wide (MSC, Eighth Annual Report, 1922, pp. 54-62).

Several decisions were made regarding the capital equipment for the plant. The electrical controls and connections were made to complete assembly of the three low-level pumps. Equipment for the power plant was purchased, tested and assembled at the Allis-Chalmers factory. The power plant consisted of four horizontal Ingersoll-Rand blowers directly connected with four Allis-Chalmers steam turbines. Each blower had the capacity to compress 30,000 cubic feet of air per minute to a pressure of 10 pounds per square inch. Four Spray Engineering Company air washers and coolers were also provided, one for each blower unit. The entire mechanism was connected to three Allis-Chalmers steam turbines capable of providing 625 kilowatts of power each. The assembled plant actually cost $30,000 less than bid, or $520,000. By the end of the year, all the equipment was ready for installation pending completion of the Power House superstructure (Ibid., p. 57).

A boiler plant was designed to provide steam for the turbines and on 1 June, contracts for a total ot $283,550 were executed to equip the plant. They included four Heine cross-drum type boilers each fed by a Westinghouse automatic stoker, two Sturtevant economizers to heat the boiler feed water, and four Foster-type superheaters to keep the steam temperature at 518 degrees. Coal and ash handling equipment was designed to produce the least dust and dirt.

As with the power plant, assembly of the boiler plant had to await completion of the superstructure. Hatton's report to the Commission said, "With the plant as designed, we believe one battery of boilers, operated at 200 percent rating, will give us all the steam required to operate the plant up to the 1930 period and the other two boilers will be needed only as spares until after that time" (Ibid., pp. 58-61).

The issuance of plans and specifications for the aeration and sedimentation tanks in November marked the successful completion of 5 years of experimentation on the most efficient means by which to digest the raw sewage and to separate the sludge from the liquor. The tanks and conduits covered 11.6 acres, most of which was lakefill. Twenty-four aeration tanks were provided, each 45 feet wide and 236 feet long with an effective depth of 15 feet of liquor. Eleven sedimentation tanks, each 98 feet in diameter with a 15-foot effective depth, were designed to accept the mixed liquor following aeration. Four smaller tanks, each 43 feet 4 inches in diameter with a 15-foot depth, were designed to assist in conditioning the waste sludge which would be dewatered and reduced to fertilizer. The tanks were designed so that each could be taken out of operation for repairs and cleaning without affecting the operation of the rest of the process (Ibid., pp. 63-4).

Experimentation determined that the most efficient amount of air to be injected into the mixed liquor was 1.5 cubic feet per gallon of sewage treated. The air diffusers were spaced to give 1 square foot of diffuser surface to 4 square feet of liquor surface. The aeration surface was designed to treat 15 MGD per acre based on an average dry weather flow. All conduit and main air feed piping systems were sized for 1950 rather than 1930 average flows (Ibid., p. 64).

On 27 January 1922, the contract for construction and installation of the aeration tanks, sedimentation tanks, connecting galleries, and all necessary equipment, was awarded to the DuPont Engineering Company of Wilmington, Delaware, for a record amount of $726,188, not including equipment and materials supplied by the Commission. This project was to be completed by the end of the year, but because of unspecified problems, only 37 percent of the work was finished. The tanks were not completely finished until early 1924, more than a year beyond the original deadline. Construction of the Power and Boiler House superstructures also began in 1922 under contract with Paul Riesen's Sons Construction Company and were also finished in the spring of 1924 (MSC, Ninth Annual Report, 1923, pp. 42-3 and 45).

In 1922, a breakthrough was made in the dewatering of the recovered sludge. The sludge collected in the sedimentation tanks had to be dewatered from approximately 98 percent moisture to 10 percent or less. From the first days of the testing station, experiments were run to find ways to dry sludge economically. It was decided that, for dewatering to be economical, the sludge first had to be reduced to 80 percent moisture and then to 10 percent.

The first experiments with different types of mechanical filtering presses used various types of filter bags and varying temperatures, pressures and amounts of sludge. The resultant sludge was too wet, or the dewatering process was too time-consuming or too costly. A hydraulic press was tried to see what heavier pressure would yield. The results were promising, but the large press could process only 1 MG of sewage. This was not an economical solution for an 85 MGD plant.

In 1919, the laboratory began experimenting with centrifuges as a means to dewater the sludge. Some of the most advanced equipment available was tested, but the system never worked to the Commission's standards and a large number of centrifuges would have been required. The centrifuge experiment continued as the brightest hope until plant chemists discovered the Oliver Continuous Vacuum Filter in October 1921. The vacuum filter was designed for dewatering metallurgical slimes, sugar, and similar substances. A small demonstration test model was set up in the laboratory and operated almost continuously until October 1922. The apparatus was tested in all seasons with good results.

The vacuum filter consists of a large revolving drum set up in a tank into which sludge is pumped. The drum has a vacuum pump at the center which sucks filtrate through a cloth filter leaving the dryer cake on the cloth. The cake is then scraped off the cloth. The volume of filter cake produced by this method was 3 to 30 times that of the presses. With the exception of routine maintenance and repairs, the filters were self-operating. In winter, when the sludge was the most difficult to work with, one filter processed the equivalent of 2 to 3 MG of sewage each day (Ibid., pp. 46, 84).

The results of the year's testing were so positive that the Commission adopted the vacuum filter system and authorized the Chief Engineer to draw up specifications. A contract was awarded to the Oliver Company for 30 filters, 11.5 feet in diameter and 14 feet long. Experimentation with a faster rotation rate showed that the amount of sludge that could be filtered by 30 filters could also be filtered by 24, so the order was reduced to 24 filters. (Ibid., p. 46).

The vacuum filter was the solution to the one problem that had continued to plague Hatton and his staff. The Chief Engineer had been corresponding with other cities adopting the activated sludge process in both the United States and Europe and had even been sent to Europe to examine the work there in person. No one had been able to solve the dewatering problem satisfactorily. The successful operation of the dewatering process at Jones Island was truly a discovery of importance in the field and opened the way for the manufacture of a fertilizer byproduct.

The second half of the dewatering process consisted of drying the partially dewatered sludge and reducing its water content from 80 to 10 percent. Early experiments with indirect heat dryers owned by a local industry were successful and after further testing, six indirect heat dryers were purchased for the Dryer House from the Atlas Company. This was the last major component of the disposal process to be decided upon (Ibid., p. 47).

As work continued in 1923 on the Power and Boiler Houses and the tanks, construction on three other major buildings began. Piles for the Fine Screen, Filter and Dryer Houses were driven in early spring and construction started shortly thereafter. The superstructures for the Filter and Dryer Houses were completed in April 1925 and for the Fine Screen House in May. These were the last buildings constructed that actually housed the treatment process (MSC, Twelfth Annual Report, 1926, appended table).

The lower floor of the Fine Screen House contained the screening equipment and the plant offices and laboratory were on the second floor. As originally designed, the fine screen equipment consisted of eight revolving drum screens of the "Tark" type produced by the Link Belt Company of Chicago. Each screen had its own pit. The drum was 8 feet in diameter by 8 feet long and was covered with manganese bronze plates. The surface of each drum was covered with slots 3/32 inch wide by 2 inches long. The drums turned at speeds varying from 8 to 12 feet per minute. A brush carriage with eight brushes passed over the surface of the screen parallel with its axis at a speed of 60 feet per minute. The drums and brushes were synchronized with one another and automatically cleaned by a liquid spray. Screenings were collected and sent to the Filter House by a pneumatic ejector where they were mixed in with the dewatered sludge for drying. The capacity of the screen house is 317 MG, the maximum quantity of sewage and storm water that can reach the plant (MSC, Ninth Annual Report, 1923, p. 61).

The Filter House was divided into three large areas. The main interior room contained the 24 vacuum filters. The southern portion was originally designed as machine shop for the entire plant and the northern portion housed the machinery bay which included the receivers, condensers, pumps, heat exchangers, preheaters, the turbo generator for the heat balancing unit, air compressors for the screening ejectors and the three large Worthington vacuum pumps operating the filters. The vacuum pumps were 12 by 12 vertical triplex plunger stuff pumps installed in May 1926. One pump remains in the machinery bay but it is no longer used.

The Dryer House is adjacent to the Filter House and shares a common wall. The six Atlas type indirect heat dryers are on the first floor. Each is 7 feet in diameter, 60 feet long, and enclosed in brick. The dryers turn at 6 revolutions per minute. The filter cake enters the end nearest the furnace, is mixed with small amounts of dry sludge to assist drying, and exits the other end of the dryer. Conveyors move the material in and out of the dryer area. Each dryer was heated by a coal-fired furnace.

Originally, the exhaust gases passed through a dust chamber and out a short stack. However, problems led to significant changes in this system (Ibid., p. 62).

Work on the last of the original plant buildings began in August 1924 when piles were driven for the foundation of the Fertilizer Storage Building. This large structure was designed solely for the storage of fertilizer awaiting shipment. The original dimensions of the building were 500 feet long, 105 feet wide and 45 feet high. It was completed in July 1925 (MSC, Twelfth Annual Report, 1926, p. 27).

Although construction was completed in 1925, work continued on the dewatering process through 1927 and the plant was not officially declared complete and operational until 1 January 1929. The liquid treatment process began operation on 26 June 1925, utilizing the coarse screens, grit chambers, fine screens, and aeration and sedimentation tanks. The event was considered important enough to warrant the presence of a correspondent from the Engineering News-Record whose report was printed in the 9 July 1925 issue. Startup of the dewatering plant was not attempted. The first tests conducted in the dewatering plant on 2 November indicated several design problems and its opening was further delayed, reducing the capacity of the liquid treatment process by half through 1926.

Because of these problems, Mayor Hoan appointed a commission to investigate rumored incompetence and malfeasance by the Chief Engineer and members of his staff. Although the commission, which included individuals generally against the plant, could not find any causes for the delays other than those normally associated with the startup of a completely new process, the controversy and loss of the support of the Chairman of the Sewerage Commission contributed to Hatton's resignation in December. He was replaced by Commissioner Robert Cramer (Horvath, pp. 73-4).

Plant operation began to improve in 1927. Early in the year, approximately 35 MGD of sewage was being processed. When the dewatering problems were solved and the solids handling system was put into operation, the average flow increased to 76 MGD by the end of the year. The plant operated smoothly during 1928 and it was officially declared completed by 1 January 1929. At that time, it was the largest activated sludge treatment plant in the country.

The Development of Milorganite

The production of a fertilizer as a byproduct of the sewage treatment process was to become an important economic asset. However, the Sewerage Commission first had to devise a way to handle 100 tons of waste sludge daily. It then had to be certain that no harmful claims could be made against the product and that it would be accepted by the fertilizer industry. Thus, early in 1922, the Commission began its efforts to create a market for the dried sludge. Early tests with a Chicago fertilizer firm showed that Milwaukee's nitrogen-rich sludge could be a marketable fertilizer or fertilizer base if it could be dewatered successfully. Hatton assumed that the dewatering problem could be solved. In March 1922, he went to Washington to meet with the heads of the Bureaus of Plant Industry and Soils and with a representative of the United States Public Health Service. They developed and approved a program for conducting additional studies on the merits of the product.

The testing program was conducted at experimental farms run by the University of Wisconsin College of Agriculture at Marshfield and Hancock and at the Milwaukee County School of Agriculture on the Milwaukee County Institutions grounds in Wauwatosa. All three farms had different types of soil. At Wauwatosa, sludge was compared to similar fertilizers in growing oats, beets, onions and corn. There was no apparent difference in yield, but no measurements had been taken. A more scientific approach was taken at the University farms. The 2-year test showed the sludge to be somewhat less productive than other fertilizers (MSC, Eleventh Annual Report, 1926, pp. 51-3). Additional tests were scheduled to determine the most advantageous use of the sludge as a fertilizer.

The Commission created a fellowship at the College of Agriculture in Madison for the research of the chemical properties of the sludge and ways to market it. This approach was more scientific than those employed at the three test farms and was seen as a way to call attention to the product. A graduate student, O.S. Noer, was elected the fellow and served in that role through 1927. His work was largely responsible for many of the eventual uses of the recovered sludge. By 1925, enough testing had been done to ensure a market for the material, mainly among golf courses.

As a marketing strategy, the Commission held a contest to name its new product. Several hundred entries from around the country were received. The winner of the $250 prize, the firm of Melver and Son of Charleston, South Carolina, submitted the name "Milorganite," which stood for Milwaukee, the fertilizer's organic origin, and its high nitrogen content (Ibid., p. 9).

MAJOR PHYSICAL AND OPERATIONAL CHANGES, 1925-80

Even as the plant opened in June 1925, changes were being made to both the physical aspects of the plant and to the equipment. This happened for two main reasons. As a pioneering plant, many changes had to be made which could be recognized only after the plant was put into operation. In addition, the metropolitan area also began contributing sewage to the system following formation of the Metropolitan Sewerage Commission of the County of Milwaukee in 1921. The total sewage volume almost immediately exceeded the plant's capacity because the original 1917-19 plans were designed only for the 1920 sewage flow. The added suburban flow and the delay of full-scale operation until 1927 mandated that plans for expansion be considered almost immediately.

The major changes to the plant are listed below to indicate the degree to which the workings of the original plant were modified, even though its basic mode of operation has remained the same. The information is taken from the annual report of the year specified.

1925

A sludge acidification tank was constructed in front of the Dryer House and enclosed in a brick structure to protect the control mechanisms for the acid feed. Tests had shown that sulfuric acid added to the sludge assisted the filtering process.

A gantry crane purchased for the grit chambers replaced the locomotive crane originally used.

1926

The Acidification House began operation and construction of a small Truck Scale House was completed. However, the centrifugal pumps for acidified waste sludge disturbed the mix to the point that the vacuum filters would not function. These were replaced with the three Worthington triplex pumps.

The original sludge conveyor system in the Dryer House proved unacceptable and the entire system was replaced.

A controversy about the emissions from the Dryer House began. Attempts to eliminate the odor problem included gas washing, chemical treatments, dust collectors and condensers. In 1941, a 350-foot smoke stack was constructed to disperse the gases.

The plant started to incinerate sewage screenings in the spare dryer and, later, in the dryer furnaces.

Several mechanical modifications were made to the six Atlas dryers to increase capacity.

1927

Two additional triplex pumps were installed to elevate waste sludge to the vacuum filter.

The heat exchangers installed in the Filter and Dryer Houses to heat the sludge proved unsatisfactory and were removed from the system.

1928

Ferric chloride was added to the sludge to improve filtering efficiency.

The fourth sludge return pump was installed as the capacity of the plant was reached.

1929

Construction of the Plant Office Building began.

Plans and specifications for additions to the original plant were requested as capacity was consistently reached. By the end of the year, the plant was regularly bypassing 10 to 15 percent of the flow delivered by the interceptor system.

1930

Decisions were made to expand the original plant through a two-step process - expansion of the Dryer House to accommodate current needs and the expansion of the plant to 1945 needs.

In February, a new type of sludge clarifier developed at the plant by D.W. Townsend and James Brower was tested successfully. Ten units were ordered to replace the original Dorr thickeners in the sedimentation tanks.

In October, a contract was awarded to expand the Fertilizer Storage Building.

Construction of the Plant Office Building was completed.

1931

In connection with the plant expansion, the Fertilizer Storage Building and Dryer House extensions were completed as was the additional Return Sludge Pump House adjacent to the Power House.

1932

The addition of the three new dryers allowed the original units to be reconditioned individually to meet 1945 standards.

An Incinerator Building for burning grit and coarse and fine screenings was completed in the fall. The incinerator included two 20-ton oil burning furnaces, five vertical centrifuges, and miscellaneous collection, storage and loading equipment.

In August, the old Pump Station and Testing Station were demolished.

1934

In October, 12 new aeration tanks and 6 sedimentation tanks making up the first portion of the East Plant were completed. This increased the plant's liquid treatment capacity from 85 to 155 MGD.

1940

The Service Building was constructed for the maintenance, pipe and carpentry shops.

New mechanical coarse screening equipment was installed for the high-level coarse screens.

1941

The Dryer House Smokestack was constructed to disperse odors from the dryers. The stack was 350 feet high and had a 35-foot outside diameter at the base.

The No. 7 dryer was replaced with a Link Belt louvre-type dryer to increase capacity. This change marked the start of the plant's conversion from coal to oil.

1942

In 1941, production of a weed killing version of Milorganite called Milarsenite began. Demand for the product required the construction of a triangular addition to the Fertilizer Storage Building.

1944

A Materials Storage Shed was built between the east wall of the Dryer House and the new stack.

1946

New furnaces were installed in Dryers 1, 2 and 3.

1947

Two of the three vacuum pumps in the Machinery Bay were changed to electric-driven pumps.

1948

Overhauling of the dryers, begun in 1946, was completed.

Plans were completed to change the plant from coal to natural gas.

1949

Expansion and modernization plans for the entire plant submitted to the Commission in 1948 were approved in early 1949. They called for expansion of plant capacity over several years and replacement of much of the remaining equipment.

Conversion of the Boiler House dryers from coal to gas began.

The main sewage channel between the Coarse Screen House and the Grit Chambers was rehabilitated.

1951

Since 1947, the Commission had been building two turbo dryers, approximately 35 feet in diameter and 80 feet tall, on the south side of the Dryer House. They increased the capacity of the existing dryers by drying the 80 percent moisture sludge from the filters to 50 percent.

To increase filter capacity, four of the original Oliver vacuum filters were replaced with slightly larger models that were 13 feet in diameter and 16 feet long.

The low-level coarse screening apparatus was replaced by two mechanically cleaning traveling coarse bar screens and a belt conveyor.

1952

The final eight aeration tanks and four sedimentation tanks in the East Plant began operation. These additions and related changes increased the liquid treatment capacity of the plant to 200 MGD.

Sedimentation tank No. 7 in the West Plant was changed to produce activated sludge to keep up with plant capacity.

Three of the older West Plant clarifier driving mechanisms were replaced with open reduction drive units.

Six more vacuum filters were replaced with larger units.

Most of the larger pumps in the plant were upgraded to the extent possible.

A 48-ton mechanical rabbled incinerator was installed and the two original incinerators were removed.

1953

Six more clarifier drive units were replaced with open reduction drive units.

Six more vacuum filters were replaced with larger units.

1954

The last two clarifier drive units were replaced.

1955

Four more vacuum filters were replaced with larger units.

1956

The last vacuum filters were replaced.

Atlas Dryer No. 6, in operation since 1925, was replaced between 1954 and 1956 with a slightly larger unit of the same general type. Testing of the dryer proved satisfactory, so the Commission announced a replacement program for the 10 old units. The program was completed by 1960.

1958

All eight fine screen mechanisms were replaced with new units of similar design.

1962

The Milorganite Packaging and Loading Building and the Truck Loading Building were completed.

1969-72

General overall renovation of the power generation equipment took place. All the old boilers and power plant equipment were replaced by a new compressor building and an electrical substation.

1974

The Power and Boiler Houses were gutted and refitted as a machine shop.

DATES OF ERECTION

The year of completion for the plant buildings are listed below

They reflect the years the superstructures were completed, bearing in mind that much of the large machinery was installed months or even years after the structures themselves were completed.

Grit Chambers	1919-20
Coarse Screen House	1920
Power and Boiler Houses	1924
West Plant Aeration and Sedimentation Tanks	1924
Fine Screen House	1925
Filter House	1925
Dryer House (original section)	1925
Fertilizer Storage Building (original section)	1925
Sludge Conditioning Building	1926
Truck Scale House	1926
Administration Building	1930
Dryer House (addition)	1931
Fertilizer Storage Building (addition)	1931
Return Sludge Pump House	1931
Incinerator Building	1932
East Plant Aeration and Sedimentation Tanks (North group)	1934
East Plant Gate House	1935
Service Building	1940
Dryer House Smokestack	1942

Milarsenite Building	1942
East Plant Aeration and Sedimentation Tanks (South group)	1952
Milorganite Packaging and Loading Building	1962
Truck Loading Building	1962
Compressor Building	1972

ORIGINAL AND SUBSEQUENT OWNERS

The plantsite was obtained by the City of Milwaukee through purchase and condemnation proceedings. Ownership of the land and the plant has not changed since the original acquisition. No formal chain of the title exists in the MMSD's records but the land and the plant are still the property of the City and managed by the MMSD.

ARCHITECTS

In an attempt to provide visual cohesiveness, the project was overseen by an Art Committee of three prominent area architects: Alexander C. Eschweiler, Carl Barkhausen and Richard Philipp. The Art Committee drew up design guidelines and produced site plans and facade sketches which were adopted by the Sewerage Commission. As far as can be ascertained, only Richard Philipp was directly involved in any of the buildings. He presented facade plans and helped select materials for the Coarse Screen House and the Grit Chamber Gate Houses. The rest of the buildings were designed by contractors following these original guidelines by direction of the Commission.

ARCHITECTURAL INFORMATION

The West Plant was constructed mainly between 1920 and 1925. Modernization and expansion of equipment has been accommodated by remodelings and additions to the original buildings.

Although the primary design consideration was utility, the issue of aesthetics was addressed by the Art Committee. Historical styles, particularly of Mediterranean architecture, influenced and unified the design of the buildings. Similar scale, building materials, and motifs such as semicircular arches tie the buildings together.

The building exteriors are finished in brick ranging from reddish orange to brown. Bedford stone provides a lighter accent particularly in the string courses which mark the raised basement and attic story, and in the coping of the parapet walls. These stone elements introduce strong horizontal lines in the large scale structures and tend to divide the exterior into three distinct sections - raised basement, main story and attic - which do not necessarily correspond to the interior spaces. An interesting counterpoint is provided by tall, narrow windows set beneath semicircular arches. Although the buildings display varying degrees of detailing, they are symmetrical, ordered structures.

Coarse Screen House

This two-story structure was the first building constructed for the plant and is the only larger scale building featuring the gable roof finished with clay tile and returned eaves.

Two tiers of windows are set beneath common arches. Five such compositions appear on the south side; a one-story wing extends from the opposite side. The entrance, with entablature and surround, is centrally located in the gable end.

Maintenance Facility

The Maintenance Facility was built in 1924 as the original power house for the West Plant. The design of this structure adheres to the general theme of the Fine Screen House and other buildings. However, the composition is anchored by corner pavilions rather than a central tower. One-story entrance blocks project from the two pavilions and are highlighted by stone bands and a parapet roof. Two windows with arches and tympana appear above each entrance block; six larger windows are spaced across the facade between the end pavilions. This rhythm of openings is repeated in the two rows of rectangular windows on the upper stories.

Fine Screen Building

The Fine Screen Building is the focus of the complex by virtue of its location and detailing. It is aligned with the main entrance and faces a triangular yard defined by the Dryer House and aeration tanks/storage area.

In plan, the Fine Screen House is a rectangle with a smaller block forming the entrance area. The shallow projections of the entrance and a tower enliven the surface. The tower rises four stories and its top level features a grouping of three windows on each side to create an arcade effect.

Bands of buff stone form a rusticated raised basement, above which rises the body of the structure. This area contains tall windows topped by tympana and semicircular brick arches with buff keystone and imposts. The tympanum area of the arch consists of brick headers surrounding an inset diamond shaped brick pattern. Two of these windows are located on either side of the entrance/tower; five occur on the side elevations.

A string course separates the main section of the structure from the attic level. Pairs of unadorned rectangular windows, aligned with the main story openings, punctuate the wall surface of this area. Buff colored coping defines the roof line and the stepped parapet wall of the east and west elevations.

<u>Gallery Buildings</u>

The gallery buildings are low rectangular structures associated with the aeration tanks. Regularly spaced windows extend the length of the structure. The arched motif with solid tympanum punctuates the main level aligned with these windows. Above the string courses are groups of three smaller rectangular windows.

<u>Filter House and Dryer House</u>

The Filter House and Dryer House are adjoining buildings, two stories in height above a raised basement. The entrance of the

Filter House is centrally located and accented by a small window (exhibiting the arch motif typical of the complex) and three small, narrow windows of similar design on the upper story.

The Dryer House, of very similar design, is located southeast of the filter house adjacent to the large brick smokestack. Of particular note is the matching in styles between the original building and the east addition.

Fertilizer Storage Building

The Fertilizer Storage Building is a long rectangular structure with string course separating the two ranks of windows. A frame pent roof projects from the west face of the building to shield the railroad track area. The building was expanded to the south by a one-story addition that curves to conform to the track location. A major addition was skillfully blended with the original facade.

Plant Office Building

The Plant Office Building stands on the shore of the Kinnickinnic River. Its rectangular mass is articulated by stone bands at the basement, a string course above the second-story windows and simple rectangular window openings. The disposition of windows is regular on the side elevations. However, the eight second-story windows on the facade are placed more closely to emphasize the central entrance. The suggestion of a porch results from the slight projection of the entrance area and its parapet roof line.

Incinerator Building

The Incinerator Building is one story in height. The original rectangular plan has been extended by additions to the south. The windows are capped by the arch and tympanum composition. The west side is further decorated by a large arched window with smaller flanking windows.

Several small scale structures serve as gate houses for the grit chambers and galleries. Although repetition of decoration is apparent, these structures are distinctive because of the smaller size, simpler massing and different roof treatment.

Grit Chamber Gate Houses

The Grit Chamber Gate Houses are nicely detailed one-story brick structures raised on a stone base. A single window appears in the gable end but is scaled to adequately fill the space. Three openings punctuate the east and west elevations, with one opening devoted to the entrance set within a molded surround with simple entablature. The windows consist of small glass blocks and are topped by tympana with diamond shaped brick insets. A similar pattern is repeated in the spandrel area. A string course surrounds the building at the impost height. Rows of bricks form an entablature and suggest returned eaves on the gable ends. The roof is covered with Mission style clay tiles which harmonize with the brick walls.

Gallery Gate House

The Gallery Gate House is a small structure with windows on the gable ends. The entrance is on the south face and, like the flanking windows, has been altered. The gable roof is tiled and the eaves return.

Truck Scale House

This small, simple structure is capped by a hipped roof covered with clay tile. A modillion pattern is apparent beneath the eaves. The entrance and windows on the east and west sides are simple rectangles.

EXTERIOR AND INTERIOR FEATURES OF NOTE

Although designed with aesthetic values in mind, these are essentially utilitarian buildings both inside and out. Aside from the features noted in the previous section, there are no other noteworthy features.

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